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A METHOD FOR THE OBJECTIVE MEASUREMENT OF ACCOMMODATION SPEED OF THE HUMAN EYE*

THE ACCOMMODATION SPEED AND ITS MODIFICATION DUE TO FATIGUE, ESERINE, PILOCARPINE AND HOMATROPINE§

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Experiments for the measurement of accommodation speed go back to Volkmann who observed with a Scheiner Bar how often, during a half minute for a given distance of a needle, he could change his accommodation from near to far and back. He found an average of 1.5 seconds.

Vierodt established that the accommodation times for the seeing from near to far (NF) and seeing from far to near (FN) were related as the ratio 135 to 100. He also observed differences due to practice, fatigue, and changes in the distance to the needle.

Aeby recorded the instants of best seeing at near and at far by opening or closing a contact by which the intervening time was registered on a drum.

Barrett substantially improved upon the method of Aeby. He made the rays which originated from letters at a finite distance fall parallel upon the eye by means of a lens, so that the letters could be seen clearly with relaxed accommodation. The lens could be removed very quickly by means of a special apparatus and the eye then had to

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accommodate in order to see the letters. Here, also, the end of the accommodation process was registered by pressing a lever. The beginning of the process was marked on a drum with the removal of the added lens.

All these methods have the reaction time of the subject as a source of error. Therefore, the accommodation times, as measured by these methods, must be considered as being too long.

Recently, Bannister and Pollock described a method in which letters light up at various speeds at different distances and in different directions. Far and near letters would have to be read faster and faster until the accommodation could no longer follow. From this limiting value the accommodation speed was calculated.

The American authors Ferree and Rand constructed an apparatus on similar fundamental principles for the testing of aviator fitness. Three rotatable discs with variable sectors were placed so that illuminated letters which lay beyond at different distances and directions could be made visible in a definite sequence. The rotating speed of the discs was increased until the accommodation speed for the recognition of the letters no longer sufficed. Ferree and Rand put great emphasis upon the measurement of a total visual act; that is, the reaction time plus the accommodation speed plus eye movement. With the same apparatus, however, the visual speed of the change of an eye adjustment for two test objects lying on one line could be determined. It must be recognized that Ferree and Rand have developed an instrument which is appropriate for testing aviator fitness. However, the pure accommodation time, that is, the speed of change of the lens form in accommodation, is not determinable. The reaction time of the sensory and visual motor apparatus as well as the latent time of the ciliary muscle still remain as errors. The retardation of the accommodation impulses, due to distractions of concentration, were also measured in the determination of the accommodation speed.

With the above methods the following results were found. According to Vierodt, the accommodation time for the change from near to far is related to that from far to near in the ratio of 100 to 135; according to Aeby, 100 to 150. Bannister and Pollock measured an average accommodation speed of 0.4 to 0.5 seconds. C. J. Robertson, who made his measurements with the apparatus of Ferree and Rand, found the range in the accommodation (time) from near to far to be from 0.718 to 1.1 seconds and for the accommodation (time) from far to near to be from 0.487 to 1.155 seconds.

Since the objective accommodation time cannot be determined according to the above methods, a new method was developed, using an entirely different principle to record directly the form changes of the lens. This made it possible to measure the beginning and ending of the lens changes, that is, the objective accommodation time.

METHOD

In this section a new method will be described for the measurement of accommodation time which depends upon the photographic recording of the size changes of the so-called Purkinje-Sanson lens mirror images which occur during accommodation.

If one allows light to fall upon the eye from one side, and then observes from a corresponding position on the opposite side of the eye, three mirror images of the light source will be seen. The first, bright, erect and virtual image is reflected from the front surface of the cornea. Within the pupil appears a second, larger, likewise erect and virtual, however not so bright image that is reflected from the front surface of the lens. Next to this, one sees a small, inverted, real, relatively bright image. This arises from the rear surface of the lens.

During accommodation the radii of curvature of the lens surfaces change. The greatest change is shown by the front surface of the lens. During accommodation for a distant fixation point the lens is (nearly) flat, during observation of a near point it is more curved. The mirror images of one and the same light source for a constant distance are large when produced by a spherical surface with a large radius of curvature and are small when produced by a spherical surface with a small radius of curvature. Accordingly, the Purkinje lens-mirror images for distance vision are large and become small for near vision. One can, therefore, utilize them to observe the accommodation process.

Figure 1 shows the scheme of the apparatus used to measure the accommodation time. Since a very high intensity is needed, an arc lamp (B1) was placed diagonally in front of the eye as a source from which the condenser lens (C) (12.5 D.) throws a converging light bundle upon two vertical slits (S). In order to obtain a focal point as sharp as possible, an added convex lens (5.5 D.) which is not shown in the scheme was placed between the condenser lens and the slit directly in front of the latter. The positioning of these lenses was chosen so that the focal point falls upon the lens of the eye. The slits appear to the eye, therefore, as separated light sources and are individually reflected from the mirror surfaces.

As already mentioned, the curvature of the front surface of the

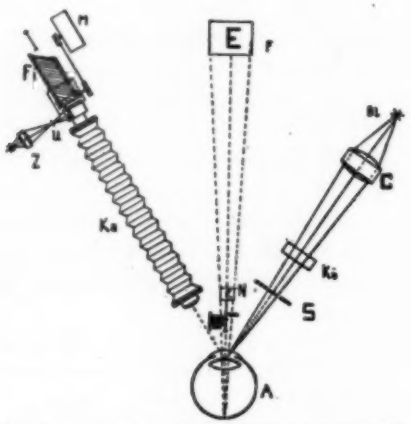

Fig. 1—Schematic plan of apparatus used to measure accommodation speed. A, Eye; Bl, arc lamp; C, condenser lens; Ku, cooling cell; S, slit; N, near point letter and electromagnet; F, distant letter; Ka, camera; Z, time recording arrangement with light source, condenser and slit; U, interrupting clock; Fi, film and kymograph; M, spring motor.

lens changes most during the accommodation process. Consequently, the reflected image from this surface (second Purkinje-Sanson image)* will show the largest size changes. We could, therefore, in our measurements disregard the third image.**

Figure 2 shows photographs of the slit images from the front surface of the lens. The distance between the light strips is clearly dimin-

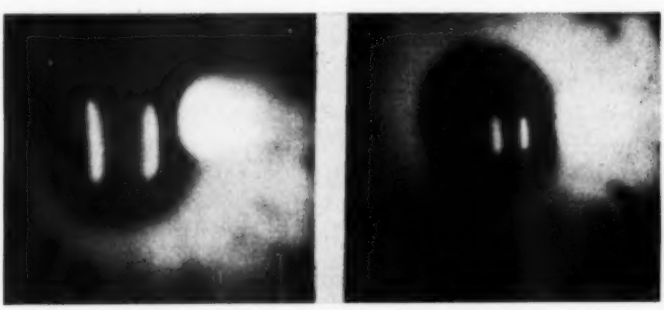

Fig. 2—Photographs of slit images reflected from the front surface of the lens. Lens focused for 5.5 m and 15 cm.

ished with accommodation for a near point. To the right of the pupil one sees the bright and over-exposed corneal image.

*Translator's note: Strictly speaking, this is the third Purkinje-Sanson image.
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For the recording of the pictures a camera (Ka.) with a Zeiss-Tessar objective of 25 cm. focal length was used and was set up in an observing position at an angle to the line of sight equal to, but opposite that of the arc lamp. With a bellows length of approximately 115 cm. and a separation of the objective from the eye of about 35 cm., a magnification ratio of about 3.7 to 1 resulted. A ground glass served for the focusing of the image. The back of the camera is so arranged that a kymograph can be attached quickly. A cylindrical lens, built into this (kymo) which is placed (with its axis) perpendicular to the orientation of the slits, reduces the slit images (Streifen) to points on the film, thereby a greater brightness is obtained. A spring motor moves the film with a speed of about 4 cm. per second vertically from bottom to top, that is, parallel to the direction of the slit. By means of this, parallel lines are recorded from the images of the slits which are close together during near vision and move apart during the adjustment of the lens for distance. During the change to near accommodation the lines move together again (see Figure 3, I).

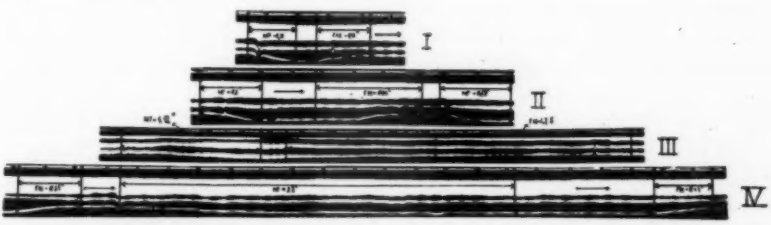

Fig. 3—Original curves, reduced approximately ⅔. I, Subj. Ma., Normal run, NF = 0.38 sec., FN = 0.43 sec. II, Fatigue due to 6 min. of alternating accommodation, Subj. Ma., NF = 0.5, FN = 0.86. III, Homatropine, 1 drop, 1% sol.; Subj. Ke., NF = 1.12, FN = 2.75 after 15 min. IV, Eserine, 3 drops, 1% sol.; Subj. Ma., FN = 0.51, NF = 3.2 after 30 min. Read from left to right. Time scale, ¼ sec.

The time recording arrangement (Z) which is attached to the side of the kymo serves to indicate the speed of the film. It consists of a light source, a convex lens, and the hand of a clock which passes through its focal point 4 times per second. Thus the light rays are interrupted for short intervals. In the kymograph there is a diagonal mirror which reflects the light upon the film. A slit imaged by the mirror will be represented as a point by means of the cylindrical lens. Thus a line which is interrupted 4 times per second will be recorded upon the moving film (see Figure 3).

The fixation direction was held constant by means of two small peep holes, which were made in the front and back surfaces of a box.

Built into this box was an electromagnet which could be operated by pressure upon a Morse key. A lever, activated by the electromagnet, covered the rear peep hole and had upon it the near fixation letter which was indirectly illuminated. As (test) letters we chose E's, since they are especially easy to recognize. The eye, the near, and the far letters were placed exactly in line. If the subject pressed upon the key, the lever was pulled to the side and the far letter could be seen in the place where, up until that time, the near letter was visible. Upon release of the key the lever was returned to its old place by means of a spring. The far letter was again covered, and the eye could accommodate on the near point without having to change the direction of fixation. The movement of the pointer was accomplished with such speed that the resulting measurements were not influenced by it.

The camera magnified approximately four times. Due to this the smallest movements of the head made difficult the focusing of the image upon the relatively narrow slit of the kymograph. Therefore, the head had to be fixed as much as possible. For this purpose, an adjustable chin rest was attached. The forehead of the subject was held by means of an adjustable block of wood, which was shaped to fit the head. The camera was so attached to the operation table that it could be adjusted for a comfortable height and proper lateral position. As a control to see that the image did actually fall upon the cylindrical lens, a window was cut into the attached piece of the kymograph, by means of which the focusing could be controlled and improved during the exposure.

To avoid harming the eye by the very bright and hot arc light, a cooling cell (Ku.) with a copper sulphate solution, which absorbed the red rays without essentially affecting the exposure time of the film, was placed between the condenser lens and the slit.

In the following summary the most important dimensions of the experimental set-up as they were used in our experiments are shown:

Condenser lens: 12.5 D.
Added Convex lens: 5.5 D.
Slit Width: 0.5 mm.
Slit Length: 1.2 cm.
Distance between arc lamp and condenser lens: 10.5 cm.
Distance between slit and condenser lens: 24 cm.
Distance between slit and eye: 10 cm.
Distance between eye and camera objective: 31 cm.
Distance between objective and film or ground glass: 115 cm.
Camera objective focal length: 25 cm.

Stop opening: 6.3.
Film speed: 4 cm. per second.
Angle between illumination direction and camera axis: 60°
Angle between direction of regard and illumination direction, or camera axis: 30°

Figure 4 shows the relationship between slit image sizes and object distance. With varying object distances from 15 cm. to 5 M., the mirror

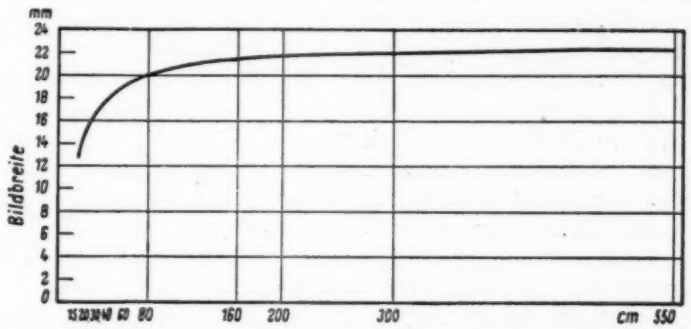

Fig. 4—The change in mirror image size with increasing object distance [Trans. note: Ordinate—Image size (mm). Abscissa—Object distance (cm)].

image from the front lens surface was photographed and then measured under approximately 20 times magnification. A curve resulted which takes the form of a hyperbola. Its slope reduces rapidly with increasing object distance. During an accommodation from the near point out to a distance of about 2 meters, the lens image size changes very definitely. During an accommodation from 2 meters to infinity, there is essentially no change in size. The same relationship is shown in changes of the lens refracting power during accommodation which can be calculated from the lens formula $\frac{1}{a} + \frac{1}{b} = \frac{1}{f}$. If a is the object distance, b the image distance, that is the distance between the retina and the second principal plane of the reduced eye, f the focal length of the refracting media, and if b is taken to be 2.2 cm. and a varies from 15 cm. to infinity, the values of f take the form of a hyperbola, which shows the same characteristics as the curve of slit image size.

It was important in our experiments to use the full amplitude of accommodation. The distance fixation letter was placed at a distance of 5.5 meters. According to Figure 4 and from the lens formula it can be shown that beyond this distance there is hardly any accom-

modation. During near vision, on the other hand, a large increase or decrease in the refracting power is necessary for the smallest change in distance. Therefore, the lever was placed at a distance of 15 cm., that is, practically at the near point of a normal eye. While investigating ametropic eyes, the distance and near letters would have to be changed to correspond with the near and far points.

The measurement of accommodation speed proceeded as follows. The pupil of the subject was placed at the focal point of the condenser lens by the adjustment of the chin rest and the forehead rest. It was the subject's responsibility to make sure that the eye was always well illuminated. A sharp image of the slit was focused on the ground glass. It is to be noted here that it is not possible with a single setting to get a sharp image from the lens when it is focused at near and at distance, because the front lens surface moves forward during accommodation.* For sharp focusing of the lens images for near accommodation, the ground glass had to be moved back. Therefore, a middle focus was selected which would provide measurements of sufficient accuracy. The eye, near, and distance letters were aligned. After complete focusing the kymograph was put in place of the ground glass. By means of adjustment of the camera table, the slit images were brought on the cylindrical lens (of the kymograph), the cover opened and the motor started. The subject was reminded to accommodate as quickly as possible from near to far, as well as from far to near.

The image from the front surface of the lens was rather dim. It was possible with relatively short exposure times to obtain useful photographs only when very sensitive film material and especially high contrast developer were used. Isopan-Ultra-Film, manufactured by Agfa, and having a sensitivity of 23/10° Din (Weston 100) was used. Especially high contrast developer is obtained with the following developer formula:

Hydroquinone: 50 grams
Distilled water: 10 liters
Metol: 50 grams
Sodium sulphite: 1,000 grams
Sodium carbonate: 1,000 grams
Potassium bromide: 10 grams

This solution is diluted in the ratio of 1 to 1. Developing time is 14 minutes.

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*Translator's note: A second and important cause of the shift of the Purkinje image during accommodation is the change in radius of the front surface of the lens.

When the strips of film were measured, they were magnified four times, and with this magnification the slit separation for accommodation at distance was about 15 mm; for accommodation at near about 9 mm.

The amplitude of accommodation is almost fully utilized. We therefore can assume that when the slits attained their greatest separation, the adjustment of the eye for infinity had been completed, and when the smallest separation was attained the eye was focused for near. From the distance between the points at their largest and smallest separation and from the film speed as checked by the time record, the accommodation time of the eye for the change from far to near and from near to far could be calculated.

RESULTS

Before discussion of the experimental results, it must be noted that in older people it is not possible to get very sharp lens mirror images. One sees the images with blurred contours. These can be explained by the appearance of so-called nuclear images. According to v. Hess, beyond the age of 25 the refractive index of the lens changes very rapidly at the boundary between the cortex and the nucleus. The cortex and nucleus act as different media. Because of this, there is a double reflection. Both reflections overlap each other and make an accurate record impossible. Hence, investigations could only be carried out with younger people. The following results were obtained (see Table I).

TABLE I

Name	Age	Exp. No.	Acc. Time FN (sec)	No. of Changes	Acc. Time NF (sec)	No. of Changes	Diff. FN:NF = %
I Ku.	19	15	0.592	14	0.507	14	14%
IIa Ma.	20	1	0.327	4	0.231	5	29%
b Ma.		8	0.379	16	0.318	13	16%
c Ma.		11	0.335	5	0.299	5	11%
d Ma.		12	0.3536	5	0.359	5	—1.5%
e Ma.		13	0.4955	4	0.4025	3	19%
Ma.	Average		0.377	34	0.328	31	13%
IIIa Ke.	25	9	0.655	14	0.485	14	26%
b Ke.		10	0.484	8	0.415	9	14%
c Ke.			0.632	10	0.543	10	14%
Ke.	Average		0.605	32	0.484	33	20%
	Total average of all normal values of Ku., Ma., Ke.		0.505 sec.	80	0.426 sec.	78	15%

Table I shows the summary of the accommodation speeds of three male observers between the ages of 19 and 24 years. It was observed that the maximum accommodation speed throughout had no constant

value and was strongly dependent upon the concentration of the subject. Even though the attempt was made to accommodate at maximum speed, it was observed that there were considerable differences in accommodation time for the individual accommodation changes for NF or FN. Because of this, average values are shown in each case for comparison. The accommodation speed for seeing from far to near (FN) was in all cases, with only one exception (II d), considerably less than for the change from near to far (NF). Time differences of 14 per cent, 13 per cent, and 20 per cent were observed. In the comparison of average values of 14, 34, or 32 individual measurements, there resulted individual differences in the accommodation speed for FN up to 39 per cent and for NF up to 32 per cent. In one and the same subject, it could be established that there were small daily variations. All the recorded experiments of Table I were undertaken only when no special strain of the accommodation musculature had preceded.

TABLE II

Experiments for Various Fixation Distances			No. of Measurements
1. Control N = 15 cm F = 5.5 m	a) FN = 0.632″	b) NF = 0.543″	10
2. N = 15 cm F = 1.5 m	a) FN = 0.608″	b) NF = 0.5″	12
3. N = 30 cm F = 5.5 m	a) FN = 0.521″	b) NF = 0.505″	6

Table II shows the relationship of the accommodation speed to the distances of the fixation letters from the eye. With incomplete utilization of the amplitude of accommodation, the accommodation speed increases. Especially noticeable is the experiment 3a. Even though the near letter had been moved 15 cm. back from the near point, the accommodation speed changed by 17 per cent. Bringing the distant letter closer by 4 meters resulted, on the other hand, in an increase of the accommodation speed of only 4 per cent (experiment 2a). These observations correspond with the facts represented in Figure 4, which shows that in the region of the near point small changes in distance make necessary large increases or decreases in the lens refractive power. The accommodation from 2 meters to infinity, on the other hand, is correlated with practically no change in the lens form.

Figures 5a and 5b show the influence of fatigue upon accommodation time. The ciliary muscle was fatigued by 6 or 10 minute periods of accommodation changes from near to far and from far to near. Both experiments show that the fatigue has its most pronounced slowing effect on the change from far to near. We obtained changes of 29 per

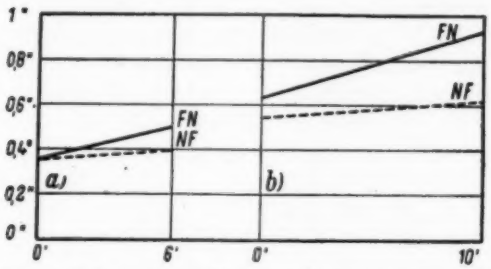

Fig. 5—The effect of fatigue of the ciliary muscle upon accommodation speed. (a) Fatigue after 6 minutes of change from far to near and near to far. (b) Fatigue after 10 minutes [Trans. note: Ordinate—Acc. time (sec.), Abscissa—Time (min.)].

cent and 36 per cent of the normal value. An original curve from these experiments is shown in Figure 3, II. In the above-mentioned daily variations the relative changes in the accommodation speed for NF were about the same as those noted for FN. Therefore it could not have been a case of an expression of a muscular fatigue. That the accommodation speed for NF was not essentially changed by fatigue can be explained by the fact that the relaxation of the lens is accomplished without muscle functioning, that is, operates passively. It was especially noticeable in the fatigue curves that there was a long latency of the lens in the near or far adjustment which can be explained by a disturbance of concentration, due to the fatigue of the nervous elements.

Of special interest to us was the measurement of the pharmacological influence upon the accommodation time, due to certain drugs which operate upon the vegetative nervous system, such as eserine, pilocarpine, and homatropine.

Eserine and pilocarpine, together with muscarine, choline, acetylcholine, histamine, and ergotamine belong to a series of substances which stimulate the parasympathetic system. Eserine, when introduced into the conjunctival sac constricts the pupil, and in large doses induces maximum accommodation due to spasticity of the ciliary muscle. The effect on the pupil lasts from 12 to 14 hours, and the ciliary muscle spasticity lasts about 2 hours. According to Anderson it operates on the parasympathetic end organs, not as a stimulus, but rather increases their sensitivity. The effect of eserine can be counteracted by atropine. Strong doses of atropine render the eserine ineffective. After pretreatment of the eye with a weak atropine or homatropine solution, the effect (of eserine) upon the ciliary muscle can be observed with the dilated pupil. Since the pupil constriction starts later than the influence upon the

accommodation musculature and since only the early stages of the effect, that is, the time before the occurrence of complete accommodative cramp is important, we could dispense with the pretreatment with atropine.

Figure 6a shows the change of the accommodation speed for FN and NF from 0 to 30 minutes after the introduction of one drop of 1%

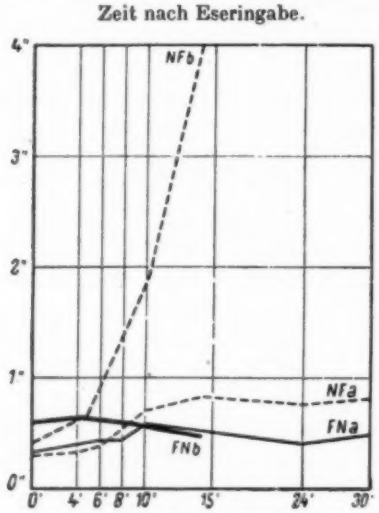

Fig. 6—Changes in accommodation speed after small and large doses of eserine. Subj. Ma. (a) 1 drop of 1% solution. (b) 3 drops of 1% solution [Trans. note: Ordinate—Acc. time (sec.), Abscissa—time after introduction of drug (min.)].

eserine solution. The accommodation speed for FN was not essentially changed, while the accommodation for NF was definitely slowed down. Maximum effect was attained after 15 minutes. With these small doses the transient accommodative cramp could be overcome in a relatively short time. Even at the instant of the strongest effect, the distant letter could be seen clearly. It may be said that stronger solutions are seldom used therapeutically.

Figure 6b shows the effect of a larger eserine dose. Three drops of the same solution were introduced. Because of the extreme pupillary constriction, photographic registration of the slit images was only possible up to 15 minutes after the introduction of eserine. Up to this time it was clearly possible to still focus for distance. The accommodation time for NF was, however, 4 seconds. The accommodation time for FN was only slightly decreased. During the strongest effect of eserine, that is, during the greatest irritability (Kontraktionbereitschaft)

of the ciliary muscle, there was noted only a small increase in the accommodation speed for FN. This indicates that in the normal experiments almost maximum accommodation speed was measured. That the accommodation speed for FN was reduced with the small eserine doses is dependent upon fatigue. The peak of the fatigue curve lies near 10 minutes, because up until that time, the pictures were taken every two minutes. After that the pauses were made longer, and recovery began.

The method gives not only information regarding the accommodation speed, but also one can read from the curves the time sequence of the accommodation process.

Figure 3, IV shows an original photograph of an eserine experiment with a large dose. The comparison with the normal photograph (Figure 3, I) shows that the accommodation speed for NF was almost normal at the beginning, and as it approached the distance setting continually reduced. The observations of the subject indicated that the eserine effect (spasm of the ciliary muscle and headache) was reduced by the use of nicotine. It is well known that after pretreatment with nicotine or curare there is no effect due to eserine. An objective control measurement could not be carried out because of the strong pupil constriction.

Figure 7 shows an experiment with pilocarpine. One drop of a 2 per cent solution was given. Pilocarpine affects the ciliary muscle as

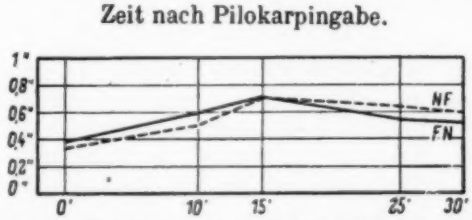

Fig. 7—Change in accommodation speed after introduction of pilocarpine (1 drop 2% solution) Subj. Ma. [Trans. note: Ordinate—Acc. time (sec.), Abscissa—Time after introduction of drug (min.)]

well as the iris muscle, although considerably less and for a shorter period than does eserine. The maximum effect was obtained in 15 minutes. Here again we see a fatigue curve for FN. The speed for NF was reduced only slightly in the doses used.

Atropine, homatropine, cocaine, together with scopolamine and adrenaline are antagonistic drugs. With these the pupil is dilated and the accommodative musculature is paralyzed at the distance setting. Homatropine affects the pupillary and accommodative musculature less

and acts for a shorter period than atropine. In spite of this, it was observed, even after 24 hours, that the lens images would not change size even with maximum effort, that is, no accommodation was possible. As long as the accommodative paralysis is not complete, as in the use of a small dose or a short time after the introduction of a large dose, the accommodation speed during accommodation for near must be reduced.

Figure 8 shows the change of the accommodation speed for FN and NF after treatment with 1 drop of a 1% homatropine solution.

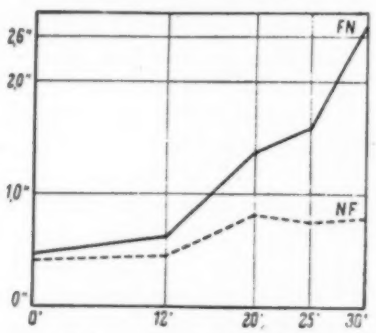

Fig. 8—Change in accommodation speed after introduction of homatropine (1 drop 1% solution) Subj. Ke. [Trans. note: Ordinate—Acc. time (sec.), Abscissa—Time after introduction of drug (min.)].

After 30 minutes it was still possible to accommodate for the near point. Influence upon accommodation speed in the sense of a reduction due to a smaller utilization of the amplitude of accommodation has not yet been found. The beginning of the effect of homatropine was noticed after 12 minutes; the maximum was not attained after 30 minutes. The accommodation speed for FN decreased 300 per cent over the daily normal value. It is remarkable that the accommodation time for NF has also changed. The decrease in accommodation speed cannot depend upon fatigue since to relax the lens, that is, to adjust it for distance, no muscle function is required, but rather only the pull of the zonule fibers is needed. The elastic powers of the zonule fibers cannot be changed by the effect of homatropine. One must, therefore, assume that the ciliary muscle affected by the homatropine shows a contracture during relaxation like that shown in fatigued skeletal muscle and therefore retards the focusing of the lens for distance. In the original curve (Figure 3, III) it will be seen that the accommodation speed for FN was again

appreciably reduced at the end of the lens movement. With increasing near focusing the accommodation speed decreased steadily. The accommodation (speed) for far was roughly decreased for the entire period.

Further experiments of the pharmacological influence on accommodation speed were not possible in this study. Just a few examples of the application of the method were shown. It would be worthwhile to study in this manner all the drugs which affect the ciliary muscle and which are used in ophthalmology.

The method described in this work for the objective measurement of the accommodation speed is hardly suited for mass investigation because of technical difficulties and large cost, therefore, it can only be used in scientific experiments. It must, however, be noted that the measurement of accommodation speed in the testing of suitability for certain occupations, for example, aviators, has great meaning in view of the large individual differences. For example, in the American Air Force periodic tests are performed with the method of Ferree and Rand.

SUMMARY

Early methods for the measurement of accommodation speed have been described. Since it is not possible to measure with these the objective accommodation speed, it was necessary to start from a new set of principles. The new method makes it possible to register photographically the size changes of the so-called Purkinje-Sanson lens mirror images during changes in accommodation.

The accommodation speed is not a constant value. It is dependent upon the will and upon concentration. Even when the subject is careful to accommodate as quickly as possible, considerable time differences were determined in different accommodative acts. For comparison, average values of several measurements were used. Small daily changes and individual differences of the maximum accommodation speed up to 39 per cent were observed. The accommodation speed for the change from far to near was on the average 15 per cent less than for the change from near to far. The mean value for the accommodation time for FN was 0.5 seconds; for NF 0.426 seconds. With the incomplete use of the amplitude of accommodation, the accommodation speed is increased. It was shown that small distance changes in near vision made necessary large changes of the refractive power of the lens. This was demonstrated in the correspondingly larger change of the accommodation speed and the increasing size change of the lens images. After fatigue of the ciliary muscles the accommodation time for FN was increased up to 36 per cent

more than the normal value. The accommodation time for NF was practically unchanged.

Several examples of the pharmacological influence on the accommodation speed were noted. Eserine, which in suitably strong doses, produces accommodative spasm at the near point, increases the accommodation time for NF to 4 seconds. The time for FN was only insignificantly shortened. Pilocarpine works similarly, being weaker and acting for a shorter time. Homatropine, which in large doses produces accommodation paralysis, in small doses or before a complete paralysis appreciably increases the accommodation time for FN. That the accommodation time for NF is also increased could be explained by a contracture of the ciliary muscle during the period of relaxation. A comparison of the eserine curves with the normal curves showed that eserine reduced the accommodation speed for NF especially in the region of the distance focus of the lens. With homatropine the lens form changes were progressively slowed during FN as the near point was approached. It was stated that the new method can only be used for the investigation of younger people, since beyond the age of 25 years the border between the lens cortex and the lens nucleus produces the so-called nucleus images which make an exact measurement impossible. The separate investigation of all pharmacologicals used in ophthalmology which have an effect upon accommodation speed would be desirable. The importance of accommodation speed measurements for the testing of suitability for certain occupations was pointed out, especially for aviators.

At the close of the work I would like to give my sincere thanks to Professor Broemser for the many sugestions and the help which he gave me.

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VISUAL CHANGES WITH AGE*

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The visual changes of age are only the manifestations of the changes taking place throughout the body. The eye, though, does have several unique characteristics which require special study to properly evaluate the changes. Moreover, this organ has so evolved both from the standpoint of function and location that it is easy to study and is valuable as an indicator of general bodily changes.‡ It is again wise to state here that each organ has its own time curve of aging and as visual specialists we must not be too quick to make positive statements concerning aging based on visual studies alone. It must also be remembered that all senescent tissues are prone to degeneration, but that not all degenerations are due to aging alone. It is often difficult to differentiate senile changes from pathologic conditions due to the fact that many eye diseases occur during the later years and yet are not necessarily a part of the aging process. The normal changes and pathologic conditions occurring in various parts of the eye as it ages are as follows:

EYELIDS AND CONJUNCTIVA

With the loss of orbital fat the eye sinks deeper into the socket. The conjunctiva contracts slightly, the skin loses its elasticity, and the muscles of the lids lose some of their tonicity, resulting in senile entropion or ectropion. This manifestation of aging is more common than we realize. In 100 consecutive cases, age 60 or over, I observed 14 with at least one eyelash rubbing on the sclera or cornea. While the condition in every case was not bad enough to be classed as entropion, a minimum of one lash was in direct contact with the conjunctiva and causing an irritation. In all cases an intense polarized light was used in the external examination.

A common change occurring as a result of hyaline degeneration, and not a deposition of fat as is often supposed, is the pinguecula.

Elderly people are more subject to various types of conjunctivitis

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‡This is Part II of the paper, "Geriatrics and Optometry." Part I appeared in the March issue. The concluding part of the paper, "The Visual Examination of the Patient Past Forty," will appear in the May issue.

due to thinness of the conjunctiva and its loss of regenerative power.

CORNEA

Arcus senilis occurs frequently in the cornea and is due to an infiltration of fat globules into Bowman's and Descemet's membranes. It often occurs as young as 30. While no treatment is necessary or advisable in most cases it must be watched. It can be the seat of the ring or gutter type corneal ulcer according to Irvine.[7]

The corneal microscope often reveals a condition known as endothelial dystrophy. This is due to small warty excrescences on Descemet's membrane. It results in gradual opacification of the cornea and loss of vision. No treatment has yet been found.

IRIS

The most obvious change in the iris in the period of later maturity is the reduction of the pupil size and the slowness of its reaction. This is due to an increase in the connective tissue and hyalinization of the septa of the sphincter. This reduction in pupil size is enough to call for a definite increase in light requirements for reading.

According to Robertson and Yudkin[8] the steady decline in the capacity for dark adaptation which accompanies aging is a result of the progressive decrease in the size of the pupil.

There is usually a fading of the color of the iris due to the depigmentation process. The migrating pigment granules can often be seen on the posterior corneal surface, in the iris stroma, or on the lens capsule.

SCLERA

The yellow appearance of the sclera is due to fatty degeneration in old age. The fibrosis of the iris and sclera is thought by some to be a predisposing cause of increased intra-ocular tension. It is at least real enough that the possibility of increasing normals for scleral tension with age should be thoroughly investigated.

LENTICULAR AND ACCOMMODATIVE CHANGES

The lens continues to grow throughout life at the periphery, thus approaching closer to the cornea. The increase in size is not actually so great, however, as the peripheral fibers which are added constantly compress the central nuclear mass.

There is much to be learned concerning the sclerosis of the lens which accounts for most of the loss of accommodation. Zoethout[9]

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[7]Thewlis, Malford W. The Care of the Aged. C. V. Mosby Co., St. Louis, Mo. 1946. p. 191.

[8]Boas, Ernst P. Treatment of the Patient Past Fifty. Year Book Publishers, Chicago, Ill. 1947. p. 428.

says that about thirty-five per cent of the lens is composed of protein material. In young eyes eighty per cent of this material is soluble; but with advancing age more and more of the proteins become insoluble, perhaps as high as fifty per cent. It is possible that the movement of the inner substance taking place when the capsule tends to assume a more spherical form becomes sluggish. At any rate the water loss and chemical change taking place does progress resulting in a gradual sclerosis and measurable loss of accommodation from age eight or as young as it has been possible to measure it.

"Second sight" experienced in some elderly individuals is thought to be more due to the loss of water content and a subsequent increased index of refraction, than it is to an actual swelling of the lens. At any rate, this condition is considered physiologic as long as the tissue remains transparent.

Due to the fact that a cataract is technically defined as an opacity of the crystalline lens or its capsule it is well to remember that very few crystalline lenses are entirely free from some sort of opacity. Koch[10] reviewed an army ophthalmological investigation of an unselected group of three hundred army men with no ocular symptoms, normal visual acuity, in good health, with average age about twenty-eight. It was found that some small opacity could be found in ninety-four per cent of the subjects. Another investigator, Vogt[11], has stated that ninety per cent of all people over sixty show senile lens changes. Small opacities which do not affect vision should be considered as a normal lenticular defect.

If the muscles operating in the eye follow the same laws of aging as the rest of the muscular system then it can be assumed that some of the accommodative loss, although a small part of it, is due to an infiltration of lipoid into the ciliary muscle. Some change must also take part in the convergence ability. Although I am not familiar with any tables showing loss of convergence ability with age such a table might be of value. If studies, say from age 50 on, do show any progressive loss of convergence it is possible that prism corrections might prove useful in old age.

There are a number of tables which show the relationship of read-

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[9]Zoethout, W. D. Physiological Optics. The Professional Press, Inc. Chicago, Ill. 1935. p. 79.

[10]Koch, Carel C., On the Preponderance of Crystalline Lenses Showing at Least Some Signs of Opacities. Am. J. Optom. and Arch. Am. Acad. Optom., Vol. 24. 1947. p. 128.

[11]Vogt, A. Atlas of Slit Lamp Microscopy of the Living Eye. Berlin. 1921. Julius Springer.

ing add to age. Hofstetter[12] in a survey of practices in prescribing presbyopic adds compares Thorington's, Donder's, Lawrence's, May's, and Landolt's tables. It is obvious from the differences presented that age alone is not a reliable indication of the reading add required. In fact, a revealing study by Bernstein[13] indicates that the differences in amplitude among patients might have an unusual significance, namely, that a statistical correlation exists between the development of presbyopia and the span of life. His work with Steinhaus and Heidemann in 1,000 cases shows that persons with early progressing presbyopia die early and that persons with late progressing presbyopia die late. The correlation was also primarily due to the large group of cases in which "apoplexia" or chief occlusion of the coronary arteries was registered as the cause of death.

Bernstein, developing his early studies still further, has attempted to establish a law of physiologic aging based on the changes revealed in accommodation. He studied 3,000 cases finally selecting 344 in which presbyopia had been present more than 12 years, in which six or more prescriptions had been given, in which there were no pathology traits or more than 1.50 diopters of myopia, and in which vision was 20/20. He has achieved a method by which one may determine fairly accurately a constant which describes the exponential velocity of the change with age with the total spherical refraction of the subject. He says that it is reasonable to assume that a correlation exists between the velocities of desiccation of various tissues of the body with age because of the studies of Steinhaus and Heidemann. This could be questioned on the basis of the investigators mentioned previously who state that each organ has its own curve of aging. There is a possibility, though, that Bernstein has found a definite relationship between early progressing presbyopia and changes in certain parts of the circulatory system. In other words, the same type of change might be taking place at the same rate in these two systems.

Bernstein, as a result of this last study, has prepared a table which classifies the aging patient into (1) normal aging, (2) aging more rapidly than normal, (3) aging more slowly than normal. He does not advocate its use unreservedly because of the bias existing in his findings, namely, that they exclude cases of presbyopia of short duration, and in consequence, the cases of quick unfavorable aging. It is

[12]Hofstetter, H. W. A Survey of Practices in Prescribing Presbyopic Adds. Am. J. Optom. and Arch. Am. Acad. of Optom. Vol. 26. April, 1949. pp. 144 to 160.
[13]Bernstein, F. Law of Physiologic Aging as Derived from Long Range Data on Refraction of the Human Eye. Arch. Ophth. Nov.-Dec. 1945. 34:378.

obvious that many interesting possibilities exist for the use of his table if further investigation entirely establishes its reliability.

The Studies of Ferree and Rand[14] as shown in the following table illustrate the effect of intensity of illumination on the near point of vision and on the apparent range of accommodation.

A STUDY OF THE EFFECT OF INTENSITY OF ILLUMINATION ON THE NEAR POINT OF VISION AND THE APPARENT RANGE OF ACCOMMODATION

Effect of Increased Illumination in 12 Nonpresbyopic and 14 Presbyopic Observers

	Decreased Distance of Near Point	*Increased Range of Accommodation*
A. Effect of slightly increased illumination (from 1 to 5 foot-candles)	(1) For 12 nonpresbyopic observers (20-41 years of age): 1.8-26 mm. (2-26%)	0.18-1.19 D. (2-19%)
	(2) For 14 presbyopic observers (40-53 years of age) wearing correction from 1 to 2 D.): 90-540 mm. (18-51%)	0.33-1.3 D. (22-105%)
B. Effect of greatly increased illumination from 1 to 25 foot-candles)	(1) For 12 nonpresbyopic observers: 3-45 mm. (3-28%)	0.27-2.38 D. (3-39%)
	(2) For 14 presbyopic observers: 170-690 mm. (32-75%)	0.61-4.32 D. (48-477%)

It is obvious that the effect of increase of light intensity on the near point and on the range of accommodation is present at all ages but is greater for presbyopic eyes. These results show the need of consideration for some fixed value of light intensity for determination of amplitude and of range of accommodation.

VITREOUS

A frequent complaint of old patients is the seeing of floating spots. This is a different phenomenon than the muscae volitantes commonly seen at any age. A careful ophthalmoscopic examination actually reveals stringy vitreous opacities which move with the eye. They are due to senile disintegration of the fibrous network of the vitreous which results in the vitreous losing its gel texture and becoming more fluid. The condition does not progress to the point of affecting vision and is considered a normal aging manifestation. Occasionally cholesterol crystals will be deposited in this degenerating vitreous and results in the "synchysis scintallins."

RETINAL CHANGES WITH AGE

The retina gradually loses its transparency and luster with age and the sparkling light reflexes seen in the young is absent. Senile chorioretinitis or macular senile degeneration is a common defect in old age.

[14]Ferree, C. E., and Gertrude Rand. Intensity of Light in Relation to the Examination of the Eye. Brit. Jour. Ophth. 1936. 20:331.

The degeneration is quite slow, usually involving only one eye initially. As it progresses the pigment becomes heaped up in the macular zone, soon both eyes become involved, and adjacent to the macular area white patches of atrophy develop. This usually progresses to the point where it interferes with reading and fine visual tasks. These patients can usually be assured that peripheral vision will not be lost and that the condition will not result in blindness. Little can be done medically for true senile degeneration. Subnormal vision aids have been known to help considerably and should be tried. It is well to keep in mind, though, that malnutritions, infections, metabolic and toxic diseases many times bring about changes similar to those found in senility.

Sclerotic changes of the blood vessels of the retina are difficult to completely evaluate. Rones[2], in his chapter on "Diseases of the Eye" in Stieglitz's book of "Geriatric Medicine" says that it is necessary to differentiate between arterio sclerosis and arteriolar sclerosis. When the arterioles are involved, which is usually in middle age rather than the elderly, diverse hemorrhages and exudates are present. Usually general hypertension and cardiorenal impairment is present. Generalized arterio sclerosis in the fundus is often observed in elderly people without an associated hypertension. Over a period of time, though, there may be a gradual rise of the blood pressure, usually less pronounced than in the younger group. When that occurs the fundus shows the narrowing and straightening of the retinal arteries with the light reflex down the middle of the vessels and the pinching of veins at the arterio-venous crossing.

The diminished circulation through the sclerosed vessels so common with increasing age brings about atrophy and a cystic degeneration in the periphery of the retina. This usually results in some contracture of the visual fields. Usually the contracture is concentric and is considered normal in the senile period.

FUNCTIONAL VISUAL CHANGES

Some of the functional changes of vision have already been outlined in detail under the parts affected. Part of the loss of ability of dark adaptation, for example, is due to change of pupil size. The gradual loss of accommodation due to the sclerosis of the lens was another functional loss apparently normal to all aging human organisms. In addition to the contraction of the visual fields there is loss of ability to match colors with advancing age according to the studies of Smith.[15]

[2]Stieglitz, Edward J. Geriatric Medicine. W. B. Saunders Co., Philadelphia, Pa. 1949.

[15]Smith, H. C. Age Differences in Color Discrimination. J. Gen. Psycho. 1943. 29:191.

Some other functional losses with age which have been observed are those of reduced visual acuity and inability to resist glare.

LOSS OF VISUAL ACUITY WITH AGE.

The terms "loss of visual efficiency" or "loss of visual acuity" have been loosely used in much of our present literature. Zoethout[9] prefers the term "minimum legible" or "the power to describe the contour of a complicated pattern." The term "visual acuity" as used here refers to this ability as measured at a distance of 6 meters.

Zoethout lists the loss of visual acuity as reported by different investigators. The table of DeHaan follows:

AGE	VISUAL ACUITY
10	1.18
20	1.15
30	1.10
40	1.03
70	.70
80	.55

Javal claims that the values given by DeHaan are too low by from 25 to 33 per cent. Cohn, in examining 100 persons over 60 years old, concludes that visual acuity decreases but slightly with advancing years.

My experiences also show that the DeHaan tables seem too low. In an attempt to determine correctible visual acuity in the normal patient past 60, I selected 100 cases at random from my files. The age range was 60 to 91, with no refractive errors in the group above 2 diopters, and each case was free from any observable pathology. The vision in all cases was taken binocularly through the distance correction if any was required. The American Optical project-o-chart was used and a miss of over one letter per line counted as a miss of the entire line. The results were as follows:

VISION BINOCULARLY	PERCENTAGE OF PATIENTS
20/20 (or better)	83%
20/25	11%
20/30 to 20/50	6%

It is realized that if pathological cases were not ruled out, or if large refractive errors were included, the percentages would have been much lower. Zoethout did not mention if the tables of DeHaan were of corrected cases. This would make a difference due to the normal lens change with advancing age plus the normal refractive error for which no correction was worn. It is also possible that within the 6 per cent group whose vision ranged from 20/30 to 20/50 some undetectable type of pathology was present. At any rate it would seem

[9]Zoethout, W. D. Physiological Optics. The Professional Press, Chicago, Ill. 1935. pp. 346-359.

that there is very little loss of correctible vision for most patients past 60 if pathology is not present.

GLARE RESISTANCE

A common complaint among patients past 50 is their inability to drive at night because of the glare of oncoming headlights. This lack of glare resistance with age has also been found by several investigators. Fletcher[16] reports on the work of Lauer, Allgaier, and DeSilva which all show a loss of glare resistance with age. Fletcher in a study of 710 subjects says that his results show a relatively high degree of correlation between age and glare resistance. A summary of his tables follows: In the twenties, glare resistance was found to be the best with one in every seven below a satisfactory standard as measured by his tests. From 30 to 40, one in every three was below standard. From 60 to 70, 9 out of 10 failed, and above 70 the failure was 100 per cent.

The seriousness of this problem is apparent when we realize that if these findings were applied to the State of California over a million drivers would be substandard in this respect.*

[16]Fletcher, Edwin D. Visual Problem in Motor Vehicle Operation. Night Vision and Age. Optom. Ext. Program, Feb. and March, 1949. Vol. 3. Nos. 5 and 6.

*Part III, "The Visual Examination of the Patient Past Forty," will appear in the May issue.

ABSTRACTS

IMPORTANCE OF A ROUTINE IN THE EXAMINATION FOR PATHOLOGICAL CONDITIONS OF THE EYE. D. Humphriss. The South African Optometrist. (Johannesburg, South Africa.) 16.1.17-21. 1949.

The author emphasizes the need for a routine in the examination of the eyes for pathological conditions. He starts with the case history, symptoms, external ocular inspection and later does his ophthalmoscopy. He prefers to do his inspection of the media and internal tissues of the eye after the refractive tests to eliminate the possibility of after images. The author suggests doing ophthalmoscopy with the patient in a partially reclining position.

C. C. K.

THE USE OF FIRST AID AND TREATMENT IN EYE INJURIES. John C. Neill. Alumni Bulletin, Pennsylvania State College of Optometry. 3.6.1-10. 1949.

Chemical burns, thermal burns, electrical burns, ocular accidents due to explosions, traumatic injuries and contusions are dealt with in this paper by Neill who outlines the first aid measures to be instituted while getting the patient into the hands of an ophthalmologist. The author finds chemical burns the most common, and in these, an early and thorough irrigation with water is the best possible first aid measure to be employed.

C. C. K.

SERVING THE DIFFICULT PRESBYOPIC PATIENT WITH BIFOCALS*

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In prescribing bifocals, it is important that we learn to recognize and classify the mental conditions and aptitude of our patients. An examination and refraction of the patient's eyes will reveal their condition, but when we attempt to classify that patient's mental attitude, we must call into play tact and skills of a high order. By adroit questioning and keen observation we may be able to classify him properly and be in a position to render the best service.

Some men seem to know instinctively how to bring out the mental qualities of their patients and carry their own personality over to that patient, thus creating a large measure of confidence. But if we inquire further, it will be found that such men have been forced by some unusual circumstance in their lives to observe human behavior more keenly, as it has touched them and altered their own lives. Or, they are men who have deliberately studied to make themselves more competent to deal with people and by so doing have prepared themselves for a larger service. All of us can improve ourselves in this way if we will take the time to observe human behavior.

Study has revealed that presbyopic patients fall into four classes: (1) The philosophic type; (2) The indifferent type; (3) The exacting type; (4) The hysterical type.

Needless to say, such a classification can offer only an extremely generalized grouping, and we seldom find clear-cut examples of each type. With mental types we find a blending and overlapping resulting from all the hereditary and environmental factors which have shaped the character of the individual from infancy. We are dealing with presbyopic adults who are the products of an environment and the cumulative irritations and frustrations of a lifetime.

The philosophic patient by instinct or environment has learned how to adjust himself to the problem of living with the least possible friction. We do not need to spend much time on patients of this type; they pose no optometric problem. Prescribe bifocal lenses and they will use them,

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†Optometrist.

and probably succeed. They help to make our good reputations, because they will put up with nearly any inconvenience.

The indifferent patient constitutes a real problem but we cannot discuss him here if we are to give enough time and space to the two types that present our greatest problem and responsibility; the exacting patient and the hysterical patient.

The exacting patient gives us something to worry about and puts us on our mettle. Patients of this type are our most severe critics and they can be our most enthusiastic boosters and our most satisfactory group of patients.

Let us consider the people who make up this exacting group: They are, in great part, business men and women, teachers, office workers, and professional people. We find them among the active social, business and professional groups of every community. They are fastidious about their general appearance and better educated than the average person. They have an idea of what they want and expect you to give it to them: and usually they select their optometrist after much serious thought.

They are the people who patronize the better beauty parlors, the better ready-to-wear shops, and have been among our regular patients during the time that they needed visual correction. When face to face with presbyopia they turn to us with some misgivings in the hope that we can give them vision that will be efficient in function and natural in appearance. Usually the need of a correction for close work is only one of a number of evidences that age is rushing upon them and they cling desperately to the hope that the evidences of age can be concealed for a few more years.

The optometrist cannot put these people off with evasions. Here is where the most advanced bifocal service can be used, where the trained optometrist can make a name for himself and where the faltering man meets his most tragic failures. With patients of this type frankness is essential. Since they are usually of more than average intelligence, we can, after we know the facts, explain the details of lens construction and the factors that work for or against success, and present a definite picture of the situation. It is wrong to promise these patients too much. Even in those cases where we feel that conditions point to the probability of considerable success, it is best to promise much less than we think we can attain. It is wise to explain the necessity of having their complete confidence and cooperation. If they feel they cannot give it to you, do not be afraid to suggest that they go to someone in whom they have complete trust.

Without exception, these patients should be given an opportunity to demonstrate their working distance. For that reason no case should be completed without at least one trial period to get the correct focal distance, the arrangement that will be most pleasing to the patient. Let them move their work around, arrange the light and check head posture, and ask them over and over again which way is best. After a trial they will work out the arrangement that seems best to them and their pride of craftsmanship will keep them from blaming you if they are not entirely pleased with the end result.

It is a good idea to call aside an interested member of the family and tell them to do all they can to see that the patient carries out all instructions. Taking people into your confidence has a curious psychological effect upon them and they will do more to guarantee that the patient does his part than you can do alone.

The hysterical presbyopic patient will be found in all walks of life —among the educated and the uneducated, business and professional people, housewives, mechanics, etc. Many of these patients are emotionally unbalanced. Some are working under high tension, others are under financial stress. In fact, frequently they are individuals maladjusted to their environment and upon inquiry into their history, it will usually be found that they are poorly adjusted to the art of living.

Many verge upon some form of psychosis. Some have other health problems. We must be constantly on guard to recognize this type of patient, and while this is not always easy, there are certain characteristics that stand out.

Beware of the presbyopic patient who promises too much. He will promise to do all you ask, will be positive that he can overcome conditions that you recognize as difficult, will want bifocals prescribed when he is in no condition to receive them. In fact, he will promise to do anything just to get the lenses. The more you warn him against unfavorable conditions, the more he will promise not to blame you if success is not complete. He will do most of the talking while he is in the office, but he will come back again and again complaining of first one thing and then another, and will blame every ache and pain he has from that time on, upon his eyes.

You can recall the details of your first conversation to such a patient; you can remind him that he assumed the greater responsibilities: but he lets you know by implication that you are to blame for his failure to master bifocals. Eventually, as you repeatedly remind him that he was the one who insisted upon the arrangement, he will stop coming to you for help.

Another presbyopic patient of the hysterical type is distinguished by a marked inability to coordinate muscular movement. He seems unable to follow your instructions. It has been found that most patients who exhibit this tendency to a marked degree are usually mentally subnormal, and those who are not usually markedly illiterate.

There is still another type of hysterical presbyopic patient, the one who "just knows he cannot wear bifocals," and then sets about proving it to you and to himself. And it is in the hysterical group that we find most of the "head bobbers."

We know that most optometrists try to avoid serving the hysterical type of patient and as far as the first group are concerned, it is well to refuse treatment until they can be brought to some degree of emotional balance.

When mentally disturbed patients come to us for help, we should feel it our duty to assist them in any way we can. We are members of a profession that occupies a place of importance in the lives of many persons, and as individuals we must be constantly alert for opportunities to broaden our service.

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ABSTRACTS

CHINESE SPECTACLES. Otto Ahlstrom. The Optician. (London, England). 119. March 17, 1950. 201-208.

The author, who is Curator of the Stockholm United Optician's Museum raises the question as to the prior use of corrective spectacles and points out that there is little evidence to support the claim that Chinese made and used corrective spectacles before their use in Europe. Many early Chinese spectacles have plano white or plano colored lenses and these it is believed were used for curative purposes rather than to improve vision. Several illustrations showing types of Chinese glasses accompany the paper.

C. C. K.

CLUES IN THE RECOGNITION OF VISUAL PROBLEMS. Howard F. Haines and Sue R. Haines. The Optometric Weekly. 40.46.1745-1747. 1949.

The authors feel that the most satisfactory school visual survey should include at least the following. (1) certain visual skills tests, (2) monocular visual acuity at 20 feet, (3) a screening test for hyperopia of more than 1.5 diopters, (4) a near point of convergence test, (5) an external ocular inspection, and (6) a teacher report on the visual behavior of each student. They review the literature of proposed tests and those already in use.

C. C. K.

EYE PROTECTION IN INDUSTRY*

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The task of protecting the eyes of industrial workers from injury is one of the most important and difficult problems confronting the safety engineer. The objective of accident prevention is essentially the control of elimination of known and suspected sources of injury. The hazards of industry are known by their tragic results, i.e., by the nature and type of injury caused by such hazards. Our experience at the Roebling Company indicates that 10 per cent of our lost time cases are eye injuries, yet they account for more than 20 per cent of the total cost in medical and compensation payments. The compensation commissions of many states report the cost of eye claims to be twice the cost of the average claim.

The reduction of accident costs and the desire to prevent needless injuries are not the only reasons for the safety engineer's interest in an effective visual program. In many industries (including the Roebling Company) where eye hazards are numerous, the success of the entire safety program may depend on the results achieved by efforts toward eye protection. Effective accident control is accomplished by and through people. The very heart of a program of prevention is the training and education of all employees from the janitor to the company president. When they have acquired an understanding of the purposes and mechanics of the safety program they generally recognize their own particular responsibility necessary to its successful operation.

We at the Roebling Company are making this effort through education and training of employees in safety by emphasizing eye protection. We have selected the most spectacular type of injury—eye injuries—and by various devices, such as safety meetings, publicity, posters and other visual aids, we constantly demonstrate to all employees, including company executives, the tragedy and needlessness of this type of injury. We constantly remind them that injury or loss of their most important of the senses (their eyesight) can be prevented simply by wearing the proper type of eye protection.

If we can train our employees to acquire the habit of protecting

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their eyes on the job, we feel it will be comparatively easy to train them in other safe work practices necessary to control accidents. It can readily be seen that our entire program is dependent on the success of our efforts in eye protection.

Requiring employees to wear eye protection imposes certain obligations on management.

1. We must make it clear to all employees why this type of protection is important and necessary. We must constantly publicize the statistical information available to us about eye injuries. We must instruct and train employees continuously to recognize the existence of eye hazards in their occupations and to guard against them.
2. We must give evidence of good faith by installing where possible and practical, stationary or removable guards to control sources of eye injury. Where it is possible to reasonably revise or change an operation, this should be done.
3. The best available non-corrective eye protection equipment should be purchased and distributed without cost to the employee. It should be procured from reliable manufacturers and a ready supply of equipment specially designed for special hazards must be maintained.
4. Protective corrective eye equipment must be provided for all employees requiring same at a minimum of expense and trouble.
5. We must make it as comfortable and convenient as possible for employees to wear their eye protection by:
   a. Providing repair and adjustment service.
   b. Goggle cleaning stations.
   c. Liberal policy of replacement of old glasses.
6. In addition to the above, provide all other aids which make the plant a pleasant place in which to work, such as, constant painting, improved lighting, sanitation, etc. This contributes because it reduces eye strain, fatigue, etc.
7. A reasonable degree of discipline must be applied in this program to control the few employees who fail to react to persuasion. Discipline should be used only as a last resort.

The original eye protection program of our organization was initiated about 1925. It continued with good results until the outbreak of World War II. It then became a war casualty. Employment at our plants almost doubled from 4,500 to 8,200 at its peak. Through a combination of circumstances and conditions, the habit of wearing eye protection was lost by the majority of our employees between 1941-

1945. Since it is more difficult to revive or salvage a program which has fallen into disrepute than to initiate a new program, considerable planning was necessary before the problem was tackled.

Although our operations are of a diversified nature and include almost all of the known eye hazards and require for their protection many special types of equipment, we decided to standardize on the safety spectacle. We reasoned that it was better to get employees to wear devices which afforded partial protection 100 per cent of the time than to attempt to enforce the wearing of equipment against which the average employee objected "on account of its weight, appearance, etc., and consequently would wear only a portion of the time.

Our operations include steel making, wire drawing, tempering, galvanizing, and tinning, and cleaning houses. We have a large maintenance department with carpenter shop, machine shops, construction crews, etc. We also manufacture wire rope, cold rolled products, insulated wire and cable. Eye hazards are present in all operations.

In addition to the plain spectacle we provide spectacles with side-shields, tinted glasses, welder's hoods, and masks, plastic monogoggles, plastic faceshields, etc

Employees who need corrective glasses are instructed to consult their own professional eye man for a copy of his prescription. The company assumes the entire cost of the glasses. The employee's cost is for the professional fees of examination, diagnosis, refraction, and writing the prescription.

We recognize safety spectacles do not provide complete eye protection on many operations. However, our decision to attempt to sell to employees some form of eye protection (though admittedly inadequate in some cases) has been vindicated. Hundreds of employees who did not previously wear any eye protection in our plants acquired the habit of wearing spectacles. Over a period of time substantial numbers of employees themselves realized the need on some jobs of more complete protection than that afforded by spectacles. Many requested and received cup-type goggles, plastic monogoggles, spectacles with side shields and plastic faceshields for protection against various hazards.

One great stimulus to the program was the insistence by the company that all visitors to the plant wear safety spectacles. Another important feature of the entire program which we emphasized was the need for protection by *all* persons who entered our plants. Prior to this time it had been difficult to persuade employees to wear safety glasses at their jobs because they frequently noticed visitors exposed to the same hazards (and in many cases supervisors and executives) without safety

glasses. Our supervisors, executives and managers have led the way by setting the right example. Our plant executives all have and wear safety spectacles when they visit the various mill buildings.

With the cooperation of a large optical company a complete survey was made of our operations to determine what types of eye protection were best suited for specific eye hazards. Large bulletins were prepared and posted throughout the mills, for the guidance of foremen and plant employees. The bulletins not only included photographs of the various types of protective equipment, but also recommendations on what jobs and what operations this equipment should be used.

A large number of safety glasses which had been damaged by flying objects, acids, or hot metals, while worn by employees, are on display in our various plants; compelling evidence to all that eye protection pays. Our plant newspaper periodically features photographs of employees and the eye equipment which saved them from injury. The sound motion picture film, *"To Live in Darkness,"* was shown to hundreds of employees during their lunch period.

One of the most satisfying results of our program has been the discovery and correction of visual defects in many employees who might have postponed an eye examination indefinitely had it not been for this program. Recent months have shown a reduction in lost time eye injuries of 225 per cent over previous years.

To you professional men, may I ask your assistance in our eye protection program by:

1. Writing complete information on your prescription forms regarding eye size, bridge size, temple length, etc. Too often we have to waste both your time and ours either by sending the employee back to your office or calling you to rectify such errors or omissions.
2. An accurate description of the employee's occupation will assist you. Ask him about it. If you need more information call us.
3. Remind the employee to return to you for periodic re-examination. You know the necessity of this more than we do.

Help us to sell each patient on the importance of protecting his eyes. While we pronounce safety as our business, remember, it is yours, too.

VISUAL CHANGES IN CHILDREN ASSOCIATED WITH SCHOOL EXPERIENCE*

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There has been considerable speculation over a long period concerning possible effects upon vision of children resulting from prolonged exposure to the visual tasks imposed by the school situation. We have long been familiar with the concept of juvenile myopia and have felt that this was associated with school attendance. These concepts, however, have been based primarily upon clinical observation and little statistical evidence in their support has been reported.

Further light on this problem is shed by a survey of the visual status of school children undertaken in a community of approximately 6,000 in the State of Colorado. It is planned to resurvey these same children at annual intervals for the next nine years. Such repeated surveys will afford a longitudinal study of the changes in visual characteristics which may occur during the child's school experience.

The results of the first year's survey, however, will permit a cross sectional study of possible changes in visual characteristics. From the results of this first year's survey certain trends appear which it is felt are of sufficient significance to be reported here.

A battery of visual tests was administered to these children including a number of visual skills tests and a retinoscopic examination. Only the retinoscopic findings for the right eye will be reported here, the skills test results being reported elsewhere.

On the basis of the retinoscopic findings each child was classified as hyperopic, myopic and emmetropic.* A total of 574 children in grades one through 12 were thus classified. The percentage of individuals falling in each retinoscopic category was then computed for each grade level. The results are shown in Table 1.

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Table 1.
RETINOSCOPIC FINDINGS BY GRADES IN PERCENTAGES

Grade	% Hyperopic	% Myopic	% Emmetropic	N
1	58	15	27	43
2	57	16	27	42
3	58	16	26	36
4	69	17	14	29
5	32	36	32	22
6	39	36	35	28
7	37	42	21	62
8	25	42	33	69
9	34	48	18	85
10	28	56	16	54
11	26	42	32	57
12	38	45	17	47

It will be seen from Table 1 that the percentage of hyperopia is quite high in the early grades and decreases in the later grades while the percentage of myopia is relatively low in the early grades but increases in the later grades. A rather sharp reversal in these retinoscopic findings can be noted at grade 5. Previous to grade 5, however, the percentage of hyperopia decreases markedly and remains at a relatively low figure thereafter. The percentage of myopia, however, increases sharply at grade five and appears to continue to increase throughout the entire school period to and including grade 12. These results are shown graphically in Figure 1.

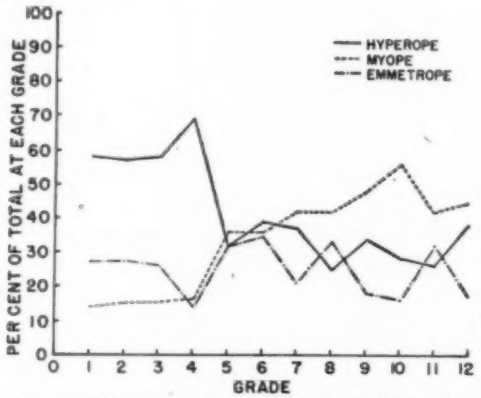

Figure 1: Percentage of children at each grade level classified in each of three categories (hyperope, myope, emmetrope) on the basis of retinoscopy.

These data would indicate that the visual tasks imposed by the school situation tend to induce myopia in children. The very sharp reversal in trend at the fifth grade level is interesting. The cause of such

reversal is not known. Many interesting hypotheses are advanced. The suggestion that at or near the fifth grade level more emphasis in the school curriculum is placed upon reading as a tool seems promising. The child "reads to learn instead of learning to read." From grade five through grade 12, however, it would appear the school tasks result in a definite trend toward myopia.

As a correlary to the above the question was raised whether or not observable differences existed in the visual status of children in the spring and in the fall. Were the myopic trends noted as a result of school attendance somewhat mitigated by the summer vacation period when presumably the visual tasks required of the child would be markedly different from those required during the school term? Here again clinical observation has long indicated that the child who shows a myopic finding at the end of or during a school term may not show this same finding after the summer vacation. However, little statistical evidence has been reported in support of this observation.

In order to test this hypothesis another school system in a Colorado community was selected where it was possible to perform a visual survey in May, toward the end of the school term and repeat the survey in September, immediately after the summer vacation. A total of 84 children were found on whom data could be made available for both testing dates.

Here again a retinoscopic examination was administered and each child was classified as hyperopic, myopic, or emmetropic in May. The examination was repeated and each child was similarly classified in September. Data thus were available for the same children tested in May and again in September.*

The percentage of children in each grade who were classified as myopic on the basis of the retinoscopic examination was computed. The results are shown in Table 2.

From Table 2 it will be seen that for the May examination the same general trend seen in Table 1 is repeated. The percentage of children classified as myopic in the lower grades is low whereas the similar percentage in the upper grades is relatively high. Again a marked change in the trend can be noted around the fifth grade level. The number of cases in the present group is smaller and consequently more irregularities appear in these data than in the former group. However, in general the same trends can be seen here.

It will also be noted from Table 2 that the percentage of myopia

*The author wishes to express appreciation to Stewart C. Lee, O.D. of Montrose, Colorado, for making available these data.

Table 2
PERCENTAGE OF CHILDREN AT EACH GRADE LEVEL CLASSIFIED AS MYOPIC ON RETINOSCOPIC EXAMINATION AT TWO TESTING DATES

Grade	Number of Cases	Per Cent Myopic	
		May, 1949	Sept., 1949
2	14	7	0
3	9	22	33
4	5	40	40
5	11	35	18
6	9	55	33
7	9	67	45
8	3	67	33
9	9	89	33
10	9	89	44
11	6	50	50
TOTAL	84	49	30

in September is higher than the percentage in May in one grade level (3). In two other grades (4 and 11) the two percentages are the same. In the remaining eight of the 11 grades the percentage myopic in September is lower than in May and in most cases this difference is marked. For all grades combined the percentages are 49 and 30 respectively. These data are shown graphically in Figure 2.

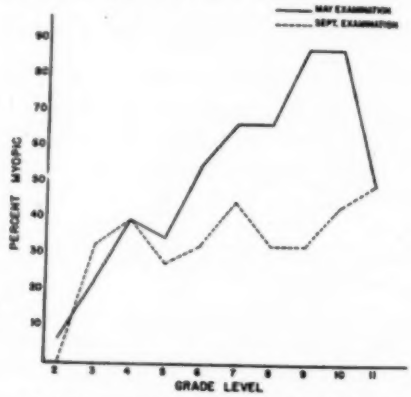

Figure 2: Percentage of children at each grade level classified as myope on the basis of retinoscopy performed at the end of the school term and repeated at the end of the summer vacation.

From these data it would appear that a change in visual status occurs over the summer vacation period when children are relieved of the visual tasks associated with the school situation. This trend is in the direction of recovery from the myopic tendency apparently induced by school work.

It will be noted in Figure 2 that both trend lines (the May examination and the September examination) in general show a rise from the early grades to the later grades. This rise would indicate that with increasing experience with visual tasks in the school situation, the tendency toward myopia increases in strength. Furthermore, it would appear that, with such increasing experience, recovery over the summer period is unable to keep up with the increase in myopic tendency and is consequently less and less complete as the child progresses through the school grades.

SUMMARY AND CONCLUSIONS

Retinoscopic examinations were administered to a group of 574 school children in grades one to 12. On the basis of these examinations each child was classified as hyperopic, myopic or emmetropic. Percentages of children in each classification were computed for each grade level. A second group of 84 children in grades two to 11 were administered a retinoscopic examination and similarly classified in May at the end of a school term. This group was examined again in September at the end of the summer vacation to determine changes in visual status associated with changing from the visual tasks of the school to the relatively different visual tasks of the summer period.

1. The percentages of hyperopia, as indicated by retinoscopic examination, is quite high in the early grades and decreases in the later grades; whereas the percentage of myopia is quite low in the early grades and increases in the later grades.

2. A marked reversal in the trends indicated by the retinoscopic examination occurs at or near the fifth grade level.

3. There is a definite trend toward a greater percentage of myopia with increasing school experience.

4. Over the summer vacation period the percentage of myopia decreases indicating a recovery from the myopic trend resulting from school experience.

5. As the grade level increases this recovery becomes less and less effective.

ABSTRACTS

OBSERVATIONS OF A VISUAL TRAINING TECHNICIAN. Dorothae Carter. The Optometric Weekly. 40.48.1815-1816. 1949.

The author reviews several training techniques of value to her in developing normal accommodative-convergence responses. She points out that age itself is not a deterrent to good visual training in selected cases and that patients achieve more rapidly when personally and individually supervised. C. C. K.

DEVELOPMENTS IN CONTACT LENS PRACTICE*

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A summary of the latest trends resulting from contact lens experiments and from further experience gained in practice shows that distinct progress in contact lens technique has been made. Some observations on present day practice may serve to clarify the stage of advancement reached with this form of ocular correction.

In striving for perfection in contact lens construction and method of fitting, two schools of thought have evolved. Both are agreed that the lens must be of "curved" construction (either pre-formed or individually moulded), as large in overall diameter as permissible without obstructing ocular rotations and for minimum corneal clearance to be present with adequate freedom in the limbus area. It has been further agreed that much greater care and painstaking accuracy is required in the fitting of minimum-clearance lenses. The days of fitting contact lenses with the deep fluid chamber are often remembered for their comparative simplicity in application. In those days, a fluid chamber generally of ½ mm. central thickness or more, was considered the correct aim for corneal clearance. Today, the corresponding accuracy in aiming to maintain that clearance has been increased more than tenfold and a specification to the nearst 1/100 mm. in the corneal fit does not represent an uncommon procedure.

Provided a well balanced haptic fit has been created, the *control* in the corneal fit now remains the outstanding factor in the final and successful contact lens toleration.

One school of thought advocates lenses fitted in minimum clearance form with the retro-lens space preferably filled with some standard contact lens solution. Although the scleral fit may be somewhat loose, allowing for more rapid interchange of lacrimal fluid than would be present in the orthodox fluid lens, an air tight fluid chamber is nevertheless created. The second school of thought, with lenses fitted in minimum-clearance form, advocates ventilation to permit a more rapid interchange of lacrimal fluid as well as to allow for normal atmospheric conditions to play their full part. A third school combining both pre-

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vious theories but advocating minimum corneal contact is not dealt with, as it is the writer's opinion that corneal clearance is a basic requirement in the fitting of any contact lens. It is conceded that, despite the difference in the first two theories, both schools combine on occasion. It is the intention to examine the merits and demerits of both methods in respect to their practical applications.

The success of toleration lies in the control and then in maintenance of minimum corneal clearance of no less than 5-7/100 mm. and no more than 10-12/100 mm. To achieve this with ventilated contact lenses is considerably more difficult than with fluid contact lenses. Because of absence of resistance of the "cushion" effect created by the fluid chamber, ventilated contact lenses settle much further onto the eye than do the liquid form lenses. Provided one starts off with full corneal clearance in the first instance, in addition to the lenses being worn regularly and daily, this "settling effect" may extend over an initial period of 4-10 weeks, before final and full bedding-down takes place. There is no apparent reason why such a comparatively long period is required or explanation as to the extent of settling. It is generally higher in eyes of flatter scleral contour.

The importance of the ventilated corneal measuring lenses, as outlined in my earlier paper, "The Practice of Ventilated Contact Lenses," (AMERICAN JOURNAL OF OPTOMETRY AND ARCHIVES OF AMERICAN ACADEMY OF OPTOMETRY, MARCH, 1949) must be emphasized again. Once the correct corneal diameter has been arrived at and the appropriate corneal sag for barest apical clearance determined, it is essential to make certain allowances in corneal height for clearance to be maintained after full settling has taken place. The specification of the desired sag to be incorporated in the final lens is of material assistance, as the patient can then use the final lens giving full clearance, in the first instance instead of an optically unworked trial shell. Many obvious and instant advantages are derived from the adoption of this procedure.

While variations may have to be introduced for some patients, the following allowances, which appear to cover the general course of practice, may serve for guidance:

For pre-formed lenses: (1) Allow 0.12 mm. extra in corneal diameter for clearance. (2) Allow 0.12 mm. extra in corneal diameter for settling during first 4-10 weeks. (3) Allow 0.12 mm. extra in corneal diameter for scleral radii over 13 mm. (Proportioned to a 22 mm. overall diameter with a standard 13 mm. corneal diameter.) (4) Allow 0.12 mm. extra in corneal diameter for absolute safety factor. This

averages 7-9/100 mm. in corneal height for each 0.12 mm. in corneal diameter.

For moulded lenses: 25-30/100 mm. ground evenly from the cast's corneal portion should, in theory, give the desired clearance. In practice, however, this has been found insufficient and a clearance of approx. 40-45/100 is much nearer the mark. I find the figure of 50-80/100, as quoted by Dudragne, high. The difference can be attributed to a flattening of the cornea when taking the moulded impression. True curves cannot be measured on a cast obtained from a mould of the eye. For this purpose, either an ophthalmometer should be employed, or preferably the ventilated corneal trial lens used. This affords a "ready picture" of the final corneal fit.

When measuring corneal height, care should be taken that the corneal trial lens does not ride on the conjunctival sulcus surrounding the limbus. For example, a lens with radius 8.5 mm. and diameter 13 mm. (8.5/13) may show clearance under the fluorescein test. A 8.75/13.25, having the same corneal sag, may on the other hand present a distinct apex touch. It is important that a pseudo-reading is not obtained, as full limbus clearance has to be incorporated in the final lens. Corneal height should therefore always be verified with a 0.25 mm. flatter corneal radius than is intended for the final specification. Disturbing bubbles may be created, however, if too flat a corneal radius is employed. Despite strongly desired freedom in the area of the limbus, too much "space" must be avoided under all circumstances. This applies to ventilated contact lenses in particular.

Following the adoption of this advocated procedure, it will be seen that the allowances made in corneal clearance in the first instance tend to leave too much "space," both centrally and at the limbus. The initial adaptation period, during which a settling-effect is observed, varies from patient to patient. The duration of settling is rarely less than four weeks and seldom more than eight to 10 weeks. This initial period may be trying for the patient in view of the visually disturbing effects the bubbles may have, particularly at night when electric lights reflect off the bubbles. The comfort of the lenses however, should not leave cause for complaint. During this period, the lenses may also take a comparatively long time to fill with the patient's own tear fluid. This may take five to twenty minutes in some cases. For the first few weeks, it may therefore be advisable to recommend the patient to fill the ventilated lenses with an artificial buffer solution when inserting. This is advantageous, as the time taken for filling is reduced and the immediate comfort increased. While the lenses may remain filled adequately for

hours, bubbles have a tendency to reappear at times. Despite all this, we are not primarily concerned as to how well the patient will do with contact lenses for the first few weeks, or even the first two or so months, we are essentially concerned how well the patient will do in six month's time and in the long run. Provided the patient has worn the lenses regularly during these initial weeks, the practitioner can then carry out the final settling if more than the desired corneal clearance is established. However great the temptation may be, the lenses should not be settled until this span of time has elapsed. I have often been surprised at the extent of settling which can take place. Laboratory technicians maintain that regrinding of the internal optic of final lenses is rarely successful. In consequence one has had to learn from bitter experience to allow for sufficient clearance in anticipatory compensation for the subsequent settling.

Excessive corneal clearance, lifting the plane of the ventilation further off the eyeball than in the final form, may tend to create a clicking sensation upon blinking. If the position of the vent has been placed too far inwards, and not at the correct position bisecting the visible limbus line, a mushroom pattern may be observed by oblique ophthalmoscopy in the outer structure of the cornea, generally confined to the stratified epithelium layer. This "mushroom" area is located at the position of the ventilation and is forcefully created by the pressure of the escaping bubble. Care should therefore be taken to place the ventilation accurately, when the gaze is directed in the primary position. In their final form, the cosmetic appearance of ventilated contact lenses is equally pleasing as with fluid lenses. Correct positioning of the vent makes the lens as invisible even to a trained observer. Ventilated contact lenses, fitting more loosely than fluid lenses, may cause some displacement of the vent on extreme rotations.

When ventilated lenses are positioned further from the corneal plane than in their final form, as initially they have to be, over-action of the sebaceous glands of the eyelids is sometimes observed. Such an increased sebaceous discharge may on rare occasion be accompanied by emphysema of the upper eyelids. In an isolated case, excessive clearance may also cause corrugation of the corneal epithelium accompanied by discomfort. These conditions subside when the lenses are settled in their final plane.

A single vent positioned within the palpebral apertures will suffice in the majority of patients, although sometimes one or two, or more, vents are indicated. When additional vents are thought necessary, they are generally incorporated to hasten lacrimal circulation and so over-

come any observable mistiness. The necessity of further vents cannot, as a rule, be ascertained until correct minimum corneal clearance has already been established. Whereas distinct clearance may be recorded with a single ventilation, a corneal touch may be noticed in an occasional case, as soon as additional ventilation has been given. This can only be explained by the release of any liquid pressure originally exerted and thus causing further settling of the lens to take place. Re-grinding the internal corneal portion will then remain the only alternative. In rare cases, the addition of further ventilation has been known to cause discomfort and reduced toleration.

Stages in control of corneal clearance have already been dealt with in my previous paper. A few observations on the finer process of fitting between the second and third stages may prove helpful. In stage two, presenting capillary-like central clearance, it was agreed to give the ideal fit after full settling has taken place. Corneal clearance in the primary position to be maintained up to a 35 degree ocular rotation. Fluorescein not being displaced by normal lid pressure, only by strong central apical finger pressure.

A 5-12/100 mm. central clearance is the ideal to be aimed at. In those cases where the patient has a ready lacrimal circulation, the higher clearance can safely be given without fear of visually disturbing bubbles. Less clearance is called for by patients whose rate of lacrimal circulation is slower. Under this category come those patients whose lenses may fill well during the first hours of wear, but where the filling may diminish when the lenses are worn for longer periods. Certain patients desiring usage for short periods only, e. g. football players or other sportsmen, should also have their lenses prescribed with less clearance. The above are final quotations for clearance, after full settling has taken place. Should corneal touch causing corneal distortion have been permitted, the patient may find a disturbance of his visual acuity for a period after reverting back to his spectacle correction.

A fair proportion of patients can achieve successful toleration with distinct capillary touch up to 5/100 mm. provided the lens has been well centered and balanced and provided corneal pressure has been distributed evenly. Corneal pressure of any description, in my opinion, is to be deprecated. Although pressure of this nature can be tolerated by some patients, the length of wearing time often tends to decrease the longer the patient uses the lenses. Quite a number of patients cannot stand corneal pressure of any description, least of all a shifting apical touch or marked limbus touch even if the pressure produced is only slight. It may not be more than 1-2/100 mm. Patients may complain of photo-

phobia and lacrimation. An ophthalmoscopic examination of the cornea may prove to be entirely negative despite extensive usage of the lens. A slit-lamp examination, however, will at times show changes in the structure of the cornea where corneal contact was allowed to be present over a period of time, either through constant central touch or through slanting peripheral touch on rotation. The picture presents an unusual pattern similar to a collection of small fatty globules or like silvery-golden rain akin to synchiasis. In advanced stages, actual corrugation of the corneal epithelium may be observed under ophthalmoscopy. In some cases a concentration of pit-like depressions, which may show up as bubble-like granulations, may be visible in the epithelium layer up to one-half to three-quarter hours after removal. This may, in effect, correspond to the "dimple veil" referred to by other writers.

Frictional corneal contact whether constant or occasional should therefore be avoided under all circumstances. As long as full clearance is maintained when directing eye movements over a central field covering an area of 70°, a slight crescent-like touch beyond has been found to be of no consequence. On a previous occasion I ventured to say that experiments with corneal lenses, which are being conducted at present, will probably demonstrate the desirability for a scleral rim to be maintained in the construction of contact lenses.

Some practitioners prefer to start fitting the lenses in minimum clearance fluid form and to ventilate the lenses only if the patient proves a stubborn veiler. Should this course be adopted, allowance in clearance for future settling after ventilation must be borne in mind. In consequence, a deeper than customary fluid chamber must be prescribed with the risk of more ready veiling, which would defeat the original object. It may therefore be reaffirmed that orthodox minimum-clearance fluid contact lenses will not lend themselves to fenestration in view of probable corneal touch caused by post-ventilation mettling. Regrinding the optic in these instances would again remain the only alternative.

In computing the advantages of minimum-clearance fluid over ventilated lenses, one must consider and assess each patient's individual problems and requirements.

The time taken for completing the original fitting is approximately equal with either form of lens. Ventilated contact lenses, on the other hand, may require additional modifications if settling of the lenses is indicated. The final fitting may then take longer to complete than would minimum-clearance fluid lenses. It may, in consequence, be argued that ventilated lenses are the more difficult to fit correctly. While

the initial comfort of the two forms of lenses is generally about the same, the ventilated type of construction may, on occasion, present visual difficulties during the first two or so months until final settling has taken place. While the onset of Sattler's Veil and mistiness is delayed with minimum-clearance fluid lenses, on rare occasions even absent for a period, it nevertheless is not overcome entirely. The practice of experimenting with various strengths solutions has now been discontinued as no material variations are recorded. 1% or sometimes 2% sodium bicarbonate in distilled water is now generally employed as a buffer. Veiling, with its limitations, still occurs with most wearers, calling for a break and change of fluid. Veiling is influenced far more favourably with ventilated contact lenses than with minimum-clearance fluid lenses. Artificial solution is also dispensed with. I will not deal with the actual problem of veiling again, this has already been covered in my two earlier papers on "Sattler's Veil." The eye stays white and clear throughout the whole period of wear, even towards the end of the day, with ventilated contact lenses. The sealed minimum-clearance lenses often give the eye a slightly strained and pinkish appearance after extended tolerance. Patients may refer to a tight and drawn feeling. This apparent difference can best be demonstrated by having a ventilated lens worn in one eye and a minimum clearance fluid lens in the other.

Ventilated contact lenses have proved to give the longer toleration and the better results by the majority of those wishing to wear contact lenses for as long a period as at all possible either for cosmetic reasons, vocational purposes or sporting events. They have also proved successful in cases where failure with any fluid form of lens was admitted. For some, ventilated lenses are unsuitable, e.g., billiard players, where the reflection off the bubbles, if present, may have disturbing visual effects. Those patients desiring only a limited tolerance of a few hours and no more, for some reason or other, may best be served by minimum-clearance fluid lenses in view of their possibly shorter period of adaptation. Advanced keratoconus may often be fitted advantageously. Some practitioners express great satisfaction with minimum-clearance fluid lenses for their general course of practice. They revert to ventilation only in cases of stubborn veilers.

Be as it may, both constructions offer advantages and limitations. On the whole, I would stress the superiority of the ventilated contact lens in the general course of practice, with usage of the minimum clearance fluid type of lens in a limited capacity. A continuous tolerance of 6-10 hours may be expected in the average patient, even after the first month. Provided the governing factors in the process of fitting

and ultimate adaptation are carefully controlled, I feel that we have now reached the stage where quite a large proportion of prospective patients are able to use this form of ocular correction satisfactorily as *entire* substitute for orthodox spectacles. Their obvious desirability as supplemental visual aids to spectacles, when medically, optically or generally indicated, need not be further stressed.

23 MANCHESTER STREET
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ABSTRACTS

PROGRESS IN MEETING THE EYE PROBLEMS OF CHILDREN. Franklin M. Foote, M.D. (Executive Director, National Society for the Prevention of Blindness, New York, N. Y.), Am. J. Public Health, 40, March, 1950, 313-316.

It is estimated that in these days when the emphasis is on visual education that at least 80 per cent of our learning comes through the sense of sight. It is, therefore, understandable that school authorities are becoming more and more concerned about the eyes of the school child. This concern has been increased in recent years by the discovery that many children who do not do well beyond the fifth grade are poor readers.

The work of many reading clinics proves that ocular factors are not the only cause of difficulty in reading. Other physical factors which require attention are: anemia, malnutrition, endocrine deficiencies, hearing loss, and systemic disease. Such psychological factors as mental retardation, neurosis and emotional problems in the home should also be given consideration. Besides the correction of ocular anomalies and other physical conditions, special training should be undertaken to improve the mechanical problems involved in the act of reading.

Visual screening tests are discussed. They include the Keystone Telebinocular, the Massachusetts Vision Test, and the regular Snellen test. Reference is also made to the study of Dr. Thomas Shaffer of Ohio State University who found that the Snellen test was "the most reliable single screening procedure when carried out carefully and with proper illumination."

The author states that school medical advisors and nurses often ask: "What shall we do when the children are taken to optometrists instead of to ophthalmologists?"

Dr. Foote points out that in this country there are only 2,000 ophthalmologists certified by the American Board of Ophthalmology, and there are 18,000 optometrists who are licensed by each of the 48 states to do refractions and to give orthoptics for muscle imbalances. A constructive plan is reported which describes how in the state of Illinois, through the efforts of the state Society for the Prevention of Blindness, a joint committee of optometric and medical eye men coordinated the screening and referral procedure in the elementary and high schools. The author concludes: "Since optometrists form a definite part of the eye-care picture in every community, this Illinois plan seems an intelligent way to meet the difficulties that often arise."

R. E. B.

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DIEHL COMMENTS ON SOCIALIZED MEDICINE IN BRITAIN

A big and great experiment is going on in England, said Dr. Harold Diehl, Dean of Medical Sciences, University of Minnesota.* Diehl, who has just returned from a 10-week study of medical education and the impact of the national health services on the professions and people of England, felt, however, that there was no need for our following in their footsteps as conditions here do not make this step necessary.

Dr. Diehl was one of three medical educators sent abroad by the American Medical Association to study medical education in the British Isles. The A. M. A. gave them a free hand to make the study as they pleased and to impartially report their findings.

*Address before the Six O'Clock Club, Minneapolis, Minnesota, February 28, 1950.

The favorable aspects of socialism in England are, said Diehl, first the government grants-in-aid to medical schools, teaching hospitals, and general hospitals. These institutions previously had been operated with deficits covered by public subscription. Now the British government pays all deficits through general taxation.

Second, medical specialists on hospital staffs are rather well off. They are free to engage in private practice on a part time basis if they wish. They are the technical directors of all hospital activities when on government service time, for which they are well compensated.

Last, the Scheme puts medical and other health care of some sort in the hands of many who, because of low income, could afford none before. Diehl claimed two-thirds of all persons in England had such low incomes as to place medical care outside the purchasing ability of these individuals.

On the other hand, Diehl found some drawbacks in the Scheme. These were:

(1) The health service costs twice as much as the largest government estimate.

(2) The plan as adopted places emphasis on quantity rather than quality of medical care. The conscientious general practitioner is penalized when he does careful work, as in so doing he has to reduce the number of persons on his panel. It must be kept in mind that the number of persons on his panel determine his annual income under the Scheme. The general practitioner is allowed 4,000 persons, and many general practitioners have enrolled this number of panel patients despite the admitted fact that no physician can do a good job on more than 1,200. In fact 800 to 900 persons would be the ideal figure.

(3) Dr. Diehl claims that under the Scheme the status of the general practitioner is nullified to a very marked degree. Instead of being the cornerstone of medical practice, the British general practitioner now is crowded out of hospitals and he no longer has access to laboratory services and the specialized diagnostic aids so essential to good medical work. He may refer patients to hospitals but not to particular specialists and after referral the case is entirely out of his hands, although the government continues to pay him his annual fee as long as the patient's name continues on his panel list. Diehl stressed the point that this type of program does not make for good medical care for the patient.

(4) With the government paying all hospital bills the beds in these institutions are filled with chronic cases while the acute cases requiring immediate care wait for bed openings.

(5) Prior to the start of the national health scheme various public health services were carried on in the British Isles, said Diehl. These had to do with the spread of communicable disease, pollution, milk inspection, dental school surveys, etc. All of these programs are at a near standstill as physicians and dentists find it more profitable to be under the Scheme and have abandoned these essential works.

(6) While there is no noticeable reduction in enrollment in medical schools there is, however, a lack of incentive for a medical education. Present students now all want to become specialists because the pay is higher, yet there are not enough hospital jobs to go around. From the standpoint of the physician in general practice, Diehl pointed out, it is extremely difficult to set up a new panel practice as all prospective patients are already enrolled on an existing panel and there is little incentive to encourage a patient to switch from one panel to another.

In closing, Dr. Diehl pointed out that the intentions of the planners were no doubt good but the national health scheme in England fails to put first things first. He suggested that we watch this experiment with interest as we will undoubtedly learn some worthwhile things from their activities. We must not assume, however, that because the British have undertaken this socialized program that we must plunge into a similar program. Standards of living are so much lower in England than here, and their swing towards general socialism so much more pronounced than here, that the over-all conditions in the two countries are not at all comparable.

CAREL C. KOCH

ABSTRACTS

FEINBLOOM TECHNIQUE IN THE FITTING OF CONICAL CONTACT LENSES. Euin Steele. The Dioptric Review and The British Journal of Physiologic Optics. (London, England.) New Series. 6.3.127-132. 1949.

A complete review of the techniques used in prescribing and fitting the conical contact lens as developed by Dr. William Feinbloom, New York City, are presented. The author includes one colored chart showing the fluorescein patterns found in improper fitting.

C. C. K.

TRANSACTIONS OF THE AMERICAN ACADEMY OF OPTOMETRY

A department devoted to announcements, reports, appointments, organization data, news, professional problems and ideals, as these relate to the Academy.

SECRETARY'S REPORT TO MEMBERSHIP

The Cleveland meeting of the Academy is now history. It is generally conceded to have been one of the finest meetings ever conducted by the Academy. The attendance was good and the four days of technical papers and section meetings were excellent. Plans are now under way for our next meeting in Chicago.

The 1950 meeting will be held at the Drake Hotel, Chicago, Illinois, December 16, 17, 18, and 19, 1950. The Illinois Chapter will assist the papers and program committee in making this coming meeting equal to or better than those before. Dr. Robert E. Bannon, chairman of the papers and program committee has sent out the annual committee notice to members who wish to present papers and the committee is now scheduling the material for the various sections.

In February, the Daniel Woolf translation of the Stenstrom research, "Investigation of the Variation and the Correlation of the Optical Elements of Human Eyes," was published in monograph form by the Academy. This significant study is now available in English. It will be mailed postpaid upon receipt of $1.00. For convenience, professionally interested persons should order by number—Monograph No. 58. Every Academy member should have a copy of this monumental work in his library.

At the present time, the advisory council under the chairmanship of past president Dr. Harold Fisher is preparing a report for President Hummel dealing with the processing of applications for Fellowship from non-practicing optometrists who are not engaged in educational or research work. The questions raised by several applications needed clarification and the results of its study will be reported at a later date. The advisory council will also study and report on the matter of processing applications for Fellowship from optometrists in foreign countries. It is expected that the advisory council will make clarifications and recommendations for the satisfactory processing of these applications by the committee on admissions.

Since the first of this year the research projects committee, under Chairman Meredith W. Morgan, Jr., has awarded three grants-in-aid to assist research projects at the Los Angeles College of Optometry and

the School of Optometry, University of California. Dr. Morgan's report appeared in the March 1950 issue of this Journal.

The committee on admittance under Chairman Arthur P. Wheelock has completed its work on several applications for Fellowship and the committee reports that 17 new applications have been received since the Cleveland meeting.

Certification of contact lens specialists by the contact lens section is making progress under the approved program adopted by the Academy. Dr. John C. Neill, section chairman, reports that he expects around 25 specialists to qualify for certification during 1950.

All Academy business and administrative supervision is conducted exclusively by the Executive Council, thus leaving our annual meetings relatively free for scientific discussion. Academy members having problems or questions relating to Academy policy or to optometry itself in those spheres touched upon by the Academy are urged to send these to the Executive Council in care of the Secretary's office. The Executive Council is in constant session by use of memoranda and matters pertaining to the welfare of the Academy and its members are given prompt attention by this body. The Council is an active administrative force on constant duty and it welcomes comments, criticisms and suggestions from members to the end that the Academy may better serve the profession.

CAREL C. KOCH

LOCAL CHAPTER ACTIVITIES

TENNESSEE CHAPTER

New officers of the newly organized Tennessee chapter are: Dr. Irving P. Filderman, Memphis, president; Dr. Tobe Self, Nashville, vice president, and Dr. George Haus, Memphis, secretary-treasurer. The chapter plans to meet with the Arkansas chapter in the near future.

SOUTHERN CALIFORNIA CHAPTER

Dr. Frank Weymouth of Stanford University was the speaker at the March meeting of the Southern California chapter. He presented a report on the relationship of eye diameter measurements to refractive states, and growth. A report on the Western Congress was given by Dr. Leslie Scown.

ILLINOIS CHAPTER

Officers who will serve the Illinois Chapter for the coming year are: Dr. Harley G. McCormack, Zion, president; Dr. Willis Brown, Elgin, vice president; Dr. Don A. Frantz, secretary-treasurer. Drs. Harry

Pine, Chicago, Eugene Freeman, Chicago, and Dr. Eugene Strawn, Freeport, will serve on the executive council.

NEW MEMBERS OF THE ACADEMY

The following optometrists and educators received their final approval for membership during the first quarter of 1950. The Academy welcomes these new members.

Dr. Edwin C. Bechtold, School of Optometry, Columbia University, New York, New York.

Lt. Albert L. Paul, Army Industrial Hygiene Laboratory, Army Chemical Center, Maryland.

CURRENT COMMENTS

Virginia Huck
Editorial Assistant

Optometrists will confer a favor by sending news items of general interest for this department: such as relate to new instruments, clinical techniques, education, visual health and optometric legislation and organization.

THE MINNEAPOLIS A. O. A. CONGRESS

Although Minnesota had its share of freak Spring weather, and Spring this year was finally dubbed "Sprinter," we can still promise with conviction that Minneapolis weather will be ideal in June for the coming A. O. A. Congress. It's bound to be either late Spring or early Summer weather, and either are delightful—balmy days and cool nights. We know A. O. A. delegates will find the Twin Cities one of the country's most pleasant spots to get together for the business sessions, education and recreation planned by Congress committees.

Speaking of Congress committees, the A. O. A. committee members report that plans are nearly complete for a fine meeting—a very fine meeting, including:

★ A delicious smörgasbord served in a beautiful country club setting, with Norwegian and Swedish folk dances for entertainment.

★ A sightseeing trip for wives along the St. Croix River, one of the most scenic in America. After the trip, luncheon at historic and famous old Lowell Inn at Stillwater, Minnesota.

★ Lectures on current problems in the optometric field. Speakers to be announced in May.

★ Luncheons, fashion teas, and a special trip to an apparel manufacturing center, for the women.

All in all, "you're going to have fun in Minneapolis," promises general chairman, Dr. Roger Lindquist, and his committee members.

If you haven't already done so, send your room reservations in *now* to Dr. Arthur Tillisch, chairman, hotel arrangements committee, 615 West Lake Street, Minneapolis 8, Minnesota.

OPTOMETRISTS MEET

A public relations conference will be an innovation at the coming Great Lakes Optometric Conference in Chicago, April 30 and May 1. Dr. Darrell B. Harmon of Austin, Texas, will present his views on proper approach to patients, colleagues and members of other professions. "Visual Rehabilitation" will be the theme of the Congress.

Minnesotans elected new officers at the 50th annual convention of the Minnesota Optometric Association in Minneapolis in February. Dr. Fred H. Rohlin, Marshall, became president; Dr. Harold Carlson, Mankato, first vice president; Dr. Leo Meyer, St. Paul, second vice president; Dr. Arthur Tillisch, Minneapolis, third vice president, and Dr. Richard Edwards, Bemidji, fourth vice president. Reelected to the secretary's office was Dr. Lorne E. Holmes, Minneapolis, and Dr. Don J. Chatham, Faribault, treasurer. Members attending the meeting heard Dr. Thaddeus R. Murroughs who at present is carrying on a research project in strabismus at the Chicago College of Optometry.

CAMPUS NEWS

Practicing optometrists of Canada will get a chance to brush up on recent developments in clinical refractive work, visual training, pathology and visual field measurements in June. The Province of Ontario Board of Examiners has announced a postgraduate course in these subjects will be held at the Ontario College of Optometry, June 19-23. Dr. Henry Hofstetter, Dean of the Los Angeles College of Optometry, is scheduled as the principal lecturer. Also lecturing will be Dr. W. T. Gratton and Dr. B. B. Sparks on ocular pathology; R. E. White, B. A. on visual perception, and W. S. Long, B. A. on theoretical optometry. The clinical work will be supervised by Dr. H. A. Stein, College clinic director. Registration forms are available from the College on request.

Dr. Daniel G. Hummel, president, American Academy of Optometry, was the commencement speaker at Pennsylvania State College of Optometry's March graduation. British student Vernon I. Ryan won the alumni award for top scholastic honors of this 32nd graduating class. Degrees were conferred on 122 seniors from 22 states, the District of Columbia, Puerto Rico, The Canal Zone, England, the British East Indies and British Guiana.

Southern College of Optometry announces the addition of three courses to its curriculum: psychological optics, reading, and illumination and seeing. The courses were added, according to Dr. W. R.

Cramer, President of the College, to give students a broader education in fields relating to vision, so they may provide better visual care for patients.

Dr. Vincent J. Ellerbrock is in charge of preparing items for display in the optometric museum planned for the new School of Optometry building at the Ohio State University. A number of items have already been collected for the museum.

The first annual workshop for practicing optometrists to be sponsored by Southern College is set for July 17-28. A total of 80 hours will be devoted to courses in psychological optics, illumination, remedial reading techniques and contact lenses. Lecturers will be Dr. M. E. Broom, Dr. C. H. Pheiffer, Dr. Irving P. Filderman, all members of the faculty. Interested optometrists are advised to write to the Workshop Director, at the College, for further information.

Open house for the public was on the April 23rd agenda of Los Angeles College of Optometry. The event was planned to give prospective optometrists and the public a chance to see the new optometry building, including the clinic, library and laboratory. Clinical demonstrations were included in each tour.

Dr. James H. Grout has resigned as President of the Northern Illinois College of Optometry. His place will be taken by Dr. Richard A. Needles, son of Dr. William Needles, former president.

A SUCCESS STORY IN OPTICS

A well earned bouquet was tossed last month to one of the frame industry's most progressive leaders. Featured in the lead article of *Monsanto Magazine* is Mr. Vincent Salierno, owner and president of Victory Optical Company. In this house organ, published by the giant Monsanto Chemical Company, producers of cellulose-nitrate used in Victory frames, the history of the frame industry is reviewed briefly, and the life story of Mr. Salierno told in "It's A Frame."

"In every industry," says the author, "there is at least one colorful personality, and into this category fits forceful Italian-born Vincent Salierno. With very little other than a firm faith in his own ability to produce a good spectacle frame, Salierno now occupies a prominent place among the frame producing companies of America. At 17 he entered the optical industry as a turner, rounding the insides of the lens' frames for a salary of four dollars a week. Today, after nine short years in his own business, Salierno owns factories in Newark and Arlington and employs over 265 people who produce one and a half million frames a year."

The article goes on to tell of Mr. Salierno's interest in styling

frames—"Commentator" and "Honey" for example—and his part in convincing people that glasses can be attractive and part of fashion accessories.

Earlier in the article, the author described the role played by various optical companies in making glasses an enhancement rather than a drawback. Mentioned are American Optical Company, Bay State Optical Company and Bausch & Lomb. The work of the Better Vision Institute in keeping America eye-minded is also covered briefly.

HARLEQUIN DISCONTINUES LICENSEES

Harlequin licensee agreements have been cancelled with other manufacturers as of March 1, according to an announcement by Martin Singer, Harlequin Corporation Sales Manager. Harlequin frames are now obtainable only through the Harlequin Corporation, 745 Fifth Avenue, New York City.

NEWS BRIEFS

Plans to get into the mushrooming television field with educational programs on eye care were made by the Better Vision Institute at its first 1950 quarterly meeting March 24. President M. J. Julian reports programs are under way on the subjects of The Light Benders, The Frame Fashioners, Gold Seekers, Glassmakers' Art, Lenses Unlimited, and Fashion's Glass. The estimated TV audience at present exceeds 18 million—a figure which will continue to increase each month. B. V. I.'s plans for 1950 also include the usual production of radio programs, news articles and educational pamphlets aimed to keep the public informed of the true facts of eye care. . . . Continental Optical Company has opened a branch office and supply depot in Dallas, Texas. . . . The clinic building of Pennsylvania State College of Optometry is currently getting a "facial." Work on the new front will be completed around June 1. . . . The Univis Lens Company has instituted a library at Dayton, Ohio, for the use of personnel of laboratories. On file are the latest ophthalmic and selling literature, available on a 30 day basis at no charge. . . . An anonymous $1,000.00 contribution was recently received by the American Optometric Foundation, according to President William C. Ezell. Said the contributor in a note accompanying the check, "Why wait and leave it in my will?" . . . Dr. Emmett A. Betts, director, The Reading Clinic, Temple University, was the featured speaker at the recent Missouri Valley Optometric Society meeting. The program also included lectures by Dr. Arnold Gesell, Yale University Clinic of Child Development, and Dr. G. N. Getman, Luverne, Minnesota, formerly a research associate of Dr. Gesell's.